# Ground-based receiver network for TEC measurements over the Peruvian sector

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## ABSTRACT

Radio beacon signals from Low Earth Orbiting (LEO) satellites have been utilized successfully to study the global ionosphere and particularly to measure the total electron content (TEC) [1,2,3]. These measurements have become crucial to provide valuable information on the electron density structure of the ionosphere and the effects of space weather on radio wave propagation including phenomena such as spread F, irregularities, and scintillation. At the Jicamarca Radio Observatory (JRO), we have developed a dual-frequency ground-based digital receiver system and a nanosatellite radio beacon for measuring TEC in the low latitude ionosphere over the Peruvian sector. This satellite instrumentation will contribute to extend the observations at the JRO from ground-based to space-based measurements and will improve the capabilities to study space weather effects in the ionosphere providing useful TEC observations for the scientific community. The ground-based receiver system is based on software-defined radio technology and was designed to detect satellite beacon RF signals. TEC is obtained by applying the phase difference technique to the 150 and 400 MHz satellite beacon signals transmitted from space. Recently, two new stations were deployed at Ancon and Huancayo and added to the JRO station to initiate a network of receivers in the Peruvian sector and contribute with TEC measurements. We will describe the final transmitter prototype, receiver systems and their technical characteristics. We present the current progress and advancements of the development of the satellite instrumentation and will show observations of TEC measurements over the Peruvian sector from the stations at the Jicamarca Radio Observatory, Ancon and Huancayo and analyze the distribution of additional stations in the Peruvian sector that will allow simultaneous TEC measurements at different locations. TEC observations from the 2016-2018 period, using beacon radio waves propagating from LEO satellites (DMSP F15 and CASSIOPE) to ground-based stations, will be shown to illustrate the behavior of the ionosphere at the low latitudes. These measurements will be complemented with ionospheric observations from other types of instruments such as ionograms from the digisonde, ISR radar electron densities and GPS TEC for representative cases to describe the ionospheric conditions at low latitudes during the last solar minimum period. In addition, the obtained TEC from the new satellite beacon receivers is compared to analog receiver measurements showing a very good agreement. The TEC observations can provide relevant information about the ionospheric plasma density variability and occurrence of plasma irregularities and therefore can be utilized as inputs for modelling tools to obtain a more detailed specification of the ionosphere and for tomographic reconstruction techniques to image the vertical structure of the topside ionospheric density profiles.

**Key words:** TEC, Radio beacon, Ionosphere, Receivers, Nanosatellite

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